TITLE OF THE INVENTION

PROBING METHOD AND PROBER

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a Continuation Application of PCT

Application No. PCT/JP02/02371, filed March 13, 2002,

which was not published under PCT Article 21(2) in

English.

This application is based upon and claims the

benefit of priority from the prior Japanese Patent

Application No. 2001-077077, filed March 16, 2001, the

entire contents of which are incorporated herein by

reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a probing method

and prober for testing the electrical characteristics of

an electrical circuit device. More specifically, the

present invention relates to a probing method and prober

which can detect the positions of the surfaces of the

electrodes of an individual electrical circuit device

formed on a test target object (e.g., a wafer W).

2. Description of the Related Art

FIGS. 9A and 9B show an example of a prober for

integrated circuits formed on a semiconductor wafer. A

prober 10 has a loader chamber 1 from which a wafer W

is to be transported, and a prober chamber 2 for

testing the electrical characteristics of the wafer W

transported from the loader chamber 1. The loader chamber 1 has a cassette support portion 3 where a cassette C for storing the wafer W is placed, a transfer mechanism (fork) 4 for transporting the wafer

5　W to the loader chamber 1, and a subchuck 5 for prealigning the wafer W on the way when the fork 4 transports the wafer W. The prober chamber 2 has a wafer stage (to be referred to as "main chuck" hereinafter) 6, a mechanism for aligning the wafer W on

10　the main chuck 6 (to be referred to as "alignment mechanism" hereinafter) 7, and a probe card 8. The prealigned wafer W is placed on the main chuck 6 with the fork 4. The main chuck 6 can move in the X, Y, Z, and θ directions. The electrodes of a plurality of

15　integrated circuits formed on the wafer W placed on the main chuck 6 are aligned with the probes of the probe card by the alignment mechanism 7 and the movement of the main chuck 6. The probe card 8 is fixed to a head plate 2A which forms the upper surface of the prober

20　chamber 2.

As shown in FIGS. 9A and 9B, the alignment mechanism 7 includes a lower CCD camera 7A and upper CCD camera 7B. The two cameras are driven under the control of a control unit. The lower CCD camera 7A is

25　provided to the main chuck 6. The lower CCD camera 7A senses probes 8A of the probe card 8 from lower side. The upper CCD camera 7B formed at the center of an

alignment bridge 7C senses the wafer W on the main

chuck 6 from upper side. The sensed images of probe 8A

and wafer W are displayed on a monitor screen 9A of a

display unit 9. The alignment bridge 7C moves in the

5   upper portion of the prober chamber 2 and along guide

rails 7D running in the Y direction from rear end

(upper portion in FIG. 9B) of the prober chamber 2 to

the probe center. The main chuck 6 has a target 7E

which can move forward and backward to above the lower

10   CCD camera 7A. The heights of the needle points of the

probes 8A are obtained by sensing the needle points

with the lower CCD camera 7A. The optical axes of the

lower and upper CCD cameras 7A and 7B are set to

coincide with each other through the target 7E. The

15   level of the main chuck 6 at this moment is used as a

reference level when performing alignment of the wafer

W and probes 8A.

A test head T is rotatably provided to the prober

chamber 2. The test head T is electrically connected

20   to the probe card 8 through an interface (not shown).

A signal from a tester is transmitted to the electrode

pads of the wafer through the test head T and probes

8A. The electrical characteristics of the plurality of

integrated circuits (chips) formed on the wafer W are

25   measured from this signal.

To bring the wafer W and probes 8A into contact

with each other with a predetermined pressure, the

surface height of the wafer W is detected. For this detection, four portions of the wafer W equiangularly distant from each other in the circumferential direction, and the center of the wafer W, i.e., five portions, are sensed by the upper CCD camera 7B while the main chuck 6 is moved in the X and Y directions. The level in the Z direction of the main chuck 6 at each sensed position is obtained as the surface height of the wafer W. The average value of the obtained heights is calculated, thus detecting the surface height of the wafer W.

Conventionally, the heights of the positions of a plurality of portions on the wafer W are detected by focusing the upper CCD camera 7B on the surface of the wafer W. In this detection process, the main chuck 6 is vertically moved toward the focal point of the upper CCD camera 7B, so that the upper CCD camera 7B is focused on the surface of the wafer W. Due to this complicated operation, focusing takes time. As the surface of the wafer W has steps, the average value of the heights of the plurality of points on the surface of the wafer W does not necessarily coincide with the surface height of the individual chip formed on the wafer W. Consequently, each probe comes into contact with different chips with different needle pressures.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to solve

one or a plurality of problems of the prior art.

According to an embodiment of the present invention, the surface height of each of a plurality of electronic circuit devices formed on a test target object such as a wafer can be detected quickly. Consequently, according to the embodiment of the present invention, there is provided a probing method and prober that can improve the throughput.

Alternatively, according to an embodiment of the present invention, there is provided a probing method and prober that perform highly reliable test under a stable needle pressure.

According to the first aspect of the invention of the present application, there is provided a prober for measuring electrical characteristics of a test target object W, the prober comprising:

a stage which places a test target object thereon, the test target object having a plurality of electrical circuit devices on a surface thereof, each of the electrical circuit devices having a plurality of electrodes on a surface thereof;

a probe card which is arranged above the stage, the probe card comprising a plurality of probes;

a first sensor which detects positions of distal ends of the probes;

a second sensor which detects a surface position of an individual one of the electrical circuit devices;

and

a controller which brings the probes of the probe card and the electrodes of the electrical circuit devices into contact with each other on the basis of the positions of the distal ends of the probes detected by the first sensor and the surface position of each of the electrical circuit devices detected by the second sensor, the controller sequentially performing the contact for each of the plurality of electrical circuit devices.

According to the second aspect of the invention of the present application, there is provided a prober for measuring electrical characteristics of a test target object, the prober comprising:

a stage which places a test target object W thereon, the test target object having a plurality of electrical circuit devices on a surface thereof, each of the electrical circuit devices having a plurality of electrodes on a surface thereof;

a probe card which is arranged above the stage, the probe card comprising a plurality of probes;

a first sensor which comprises a load sensor, the load sensor detecting whether distal ends of the probes are in contact with a surface of the load sensor;

a second sensor which detects an average position of a surface of the test target object, and

a controller which brings the probes of the probe

card and the electrodes of the electrical circuit
devices into contact with each other on the basis of
the positions of the distal ends of the probes detected
by the first sensor and the positions of surfaces of
the electrodes of each of the electrical circuit
devices detected by the second sensor, the controller
sequentially performing the contact for each of the
plurality of electrical circuit devices.

According to the third aspect of the invention of
the present application, there is provided a prober for
measuring electrical characteristics of a test target
object, comprising:

measurement means for measuring electrical
characteristics of a plurality of electronic circuit
devices formed on the test target object;

support means for placing the test target object
thereon, the test target object having a plurality of
electrical circuit devices on a surface thereof, each
of the electrical circuit devices having a plurality of
electrodes on a surface thereof;

a probe card which comprises a plurality of probes
that are connected to the measurement means;

first detection means for detecting positions of
distal ends of the probes;

second detection means for detecting a surface
position of an individual one of the electrical circuit
devices; and

control means for bringing the probes of the probe
card and the electrodes of the electrical circuit
devices into contact with each other on the basis of
the positions of the distal ends of the probes detected
by the first sensor and the surface position of each of
the electrical circuit devices detected by the second
sensor, the control means sequentially performing the
contact for each of the plurality of electrical circuit
devices.

According to the fourth aspect of the invention of
the present application, there is provided a probing
method of testing electrical characteristics of a
plurality of electronic circuit devices formed on a
test target object W placed on a stage by using a
prober having a probe, the probing method comprising:

(a) detecting a position of at least one probe
with a first image sensing mechanism;

(b) causing a focal point of the first image
sensing mechanism and a focal point of a second image
sensing mechanism to coincide with each other, to
detect positions of surfaces of the electronic circuit
devices;

(c) detecting a level of a surface of the stage;

(d) placing the test target object on the stage;

(e) aligning the probe and surfaces of electrodes
of the electronic circuit devices formed on the test
target object, the step comprising;

(e1) irradiating at least one predetermined region of the electronic circuit devices with light;

(e2) extracting reflected light from the predetermined region into a focal point detection optical system;

(e3) pupil-splitting the reflected light into first and second light in the focal point detection optical system;

(e4) obtaining defocus amounts of the surfaces of the electronic circuit devices on the basis of light quantity distributions of the first and second light; and

(e5) moving the stage on the basis of the defocus amounts, thereby causing the focal point of the second image sensing mechanism and the surfaces of the electrodes of the test target object to coincide with each other, and

(f) bringing the probes and the electrodes of the test target object into contact with each other.

According to the fifth aspect, there is provided a method of measuring electrical characteristics of a plurality of electronic circuit devices formed on a test target object by using a prober, the method comprising:

(a) detecting a position of at least one probe among a plurality of probes provided to a probe card;

(b) causing a focal point of a first image sensing mechanism and a focal point of a second image sensing mechanism to coincide with each other, to detect positions of surfaces of the electronic circuit devices;

(c) detecting a position of a surface of each of the electrical circuit devices formed on a surface of the test target object placed on a stage;

(d) placing the test target object on the stage, each of the plurality of electrical circuit devices formed on the test target object comprising a plurality of electrodes on a surface thereof; and

(e) bringing the plurality of probes and a predetermined electrode of one of the electrical circuit devices into contact with each other on the basis of the detected position of the probe and positions of the electrodes.

According to the sixth aspect of the invention of the present application, there is provided a method of measuring electrical characteristics of a plurality of electronic circuit devices formed on a test target object by using a prober, the method comprising:

(a) detecting a position of at least one probe among a plurality of probes provided to a probe card;

(b) causing a focal point of a first image sensing mechanism and a focal point of a second image sensing

mechanism to detect positions of surfaces of the electronic circuit devices to coincide with each other;

(c) detecting a position of a surface of each of the electrical circuit devices formed on a surface of

5   the test target object placed on a stage;

(d) placing the test target object on the stage, each of the plurality of electrical circuit devices formed on the test target object comprising a plurality of electrodes on a surface thereof; and

10   (e) bringing the plurality of probes and a predetermined electrode of one of the electrical circuit devices into contact with each other on the basis of the detected position of the probe and the positions of the surfaces of the electrical circuit

15   devices.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIGS. 1A and 1B are views showing a prober according to an embodiment of the present invention;

FIG. 2 is a view showing the arrangement of the

20   main part of the prober according to the embodiment of the present invention;

FIGS. 3A to 3C are front views showing the first and second view field limiting members shown in FIG. 2;

FIG. 4 is an enlarged plan view showing a region

25   irradiated by the light-irradiating means of a second sensing mechanism;

FIGS. 5A to 5C are views for explaining the

principle of auto focus by pupil splitting;

FIG. 6 is a view for explaining the light quantity distributions of pupil splitting detected by the photosensor of the focal point detection unit shown in FIG. 2;

FIG. 7 is a flow chart showing a probing method according to an embodiment of the present invention;

FIG. 8 is a flow chart showing the procedure of auto focus by pupil splitting of FIG. 7; and

FIGS. 9A and 9B are views showing a conventional prober, in which FIG. 9A is a sectional front view, and FIG. 9B is a plan view schematically showing the interior of FIG. 9A.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a probing method and prober aimed at various types of electronic circuit devices, e.g., integrated circuit formed on a semiconductor wafer or electronic circuits for liquid crystal display. To describe the present invention more specifically, in the following description, an embodiment of the present invention will be described with reference to a case in which the present invention is applied to a probing method and prober for measuring the electrical characteristics of a plurality of integrated circuits (chips) formed on the semiconductor wafer.

FIGS. 1 to 8 show the embodiment of the present

invention. The prober according to the embodiment of
the present invention is formed in the same manner as
the conventional prober except for the respects to be
described hereinafter. Hence, this embodiment will be

5 described mainly regarding the characteristic portions
of the prober. As shown in FIG. 1, a prober 10
according to this embodiment has a first sensor (image
sensing mechanism) 12 for sensing probes 8A, a second
sensor (image sensing mechanism) 7G for sensing a test

10 target object (e.g., a wafer) W on a main chuck 11, and
a controller 14 for driving the main chuck 11 on the
basis of information from the first image sensing
mechanism 12 and second image sensing mechanism 7G.
The first image sensing mechanism 12 can be attached

15 to a stage (main chuck) 11 that can move in the X, Y,
Z, and θ directions. The second image sensing
mechanism 7G can be movably provided above the main
chuck 11.

While the electrodes of a plurality of integrated

20 circuits (chips) formed on the wafer W and the probes
are in contact with each other under the control of the
controller 14, a tester TS measures the electrical
characteristics of the individual chips formed on the
wafer W through a test head T and probe card 8.

25 As shown in FIG. 2, the prober 10 further has a
third image sensing mechanism 15. When detecting the
surface heights of the plurality of chips formed on the

wafer W, the third image sensing mechanism 15 senses

the entire image of the wafer W. The second image

sensing mechanism 7G senses part of the wafer W in

enlargement. The second and third image sensing

5   mechanisms 7G and 15 have light-irradiating mechanisms

131 and 151, respectively. The surface of the

main chuck 11 is sensed with light from the

light-irradiating mechanisms 131 and 151. Namely, a

second image sensing mechanism 13 senses the surface of

10   the wafer W in a micro-visual field, and the third

image sensing mechanism 15 senses the surface of the

wafer W in a macro-visual field.

As shown in FIG. 1, the second image sensing

mechanism 13 has an objective lens 132, first half

15   mirror 133, second objective lens 134, second half

mirror 135, first visual field limiting member 136,

relay lenses 137 and 138, and CCD 139. The

light-irradiating means 131 has a light source 131A

such as a halogen lamp, condenser lens 131B, second

20   visual field limiting member 131C, and relay lens 131D.

When the second image sensing mechanism 13 is to sense

the surface of the wafer W, irradiation light from the

light source 131A of the light-irradiating means 131 is

focused by the condenser lens 131B, passes through the

25   second visual field limiting member 131C and relay lens

131D, is reflected toward the wafer W by the first half

mirror 133, passes through the objective lens 132, and

irradiates the surface of the wafer W on the main chuck
11. During this process, the irradiation light
illuminates that region on the wafer W which is limited
by the first visual field limiting member 131C. The
5   reflected light from the wafer W passes through the
objective lens 132, first half mirror 133, and second
objective lens 134, is reflected by the second half
mirror 135, passes through the third visual field
limiting member 136 and relay lenses 137 and 138, and
10   reaches the CCD 139.

As shown in, e.g., FIG. 3A, an aperture 136A can
be formed at the center of the third visual field
limiting member 136. For example, the aperture 136A
can have such a size that it can transmit only
15   reflected light from a region slightly larger than one
electrode pad P of the chips formed on the wafer W. As
shown in FIG. 3B, a first aperture 131E corresponding
to the aperture 136A of the third visual field limiting
member 136 can be formed at the center of the first
20   visual field limiting member 131C. Furthermore, a pair
of second apertures 131F can be formed on the first
visual field limiting member 131C to sandwich the first
aperture 131E between them. As shown in FIG. 4,
irradiation light from the light-irradiating means 131
25   forms a rectangular image 131E' corresponding to the
first aperture of the second visual field limiting
member 131C and rectangular images 131F' corresponding

to the second apertures 131F on the surface of the

wafer W. The reflected light is further limited by the

third visual field limiting member 136 of the second

image sensing mechanism 13, so that the image of only

5   the electrode pad P is sensed by the CCD 139.

The prober 10 comprises a focal point detection

unit 16 for auto-focusing the second image sensing

mechanism 13. As shown in FIG. 2, the reflected light

from the surface of the wafer W becomes incident on the

10   focal point detection unit 16 by the second half mirror

135 of the second image sensing mechanism 13. On the

basis of this reflected light, the focal point

detection unit 16 detects the deviation amount (defocus

amount) of the surface of the wafer W from the focal

15   point of the second image sensing mechanism 13. As

shown in FIG. 2, the focal point detection unit 16 can

have a second visual field limiting member 161, relay

lens 162, pupil splitting mirror 163, relay lenses 164

and 165, and photosensor 166. The reflected light from

20   the wafer W is split into two beams by pupil splitting.

The defocus amount is detected based on the images of

the light split into two beams. As shown in FIG. 3C,

the second visual field limiting member 161 has

apertures 161A corresponding to the second apertures

25   131F of the first visual field limiting member 131C.

The reflected light from the wafer W forms a

predetermined pattern through the apertures 161A of the

second visual field limiting member 161. The patterned reflected light passes through the relay lens 162 and is split into two beams through the pupil splitting mirror 163. The photosensor 166 detects two pairs of light quantity distributions corresponding to the two split reflected lights. The distance between the light quantity distributions of each pair (e.g., distance between barycenters, distance between peaks) detected by the photosensor 166 changes in accordance with the distance between the surface of the wafer W and the objective lens 132. The distance between the light quantity distributions of each pair detected by the photosensor 166 is subjected to arithmetic operation, so that the defocus amount can be detected. More specifically, the focal point detection unit 16 pupil-splits the reflected light from the thin elongated rectangular regions 131F' (see FIG. 3) at two portions outside the sensing region of the second image sensing mechanism 13. Thus, the defocus amount of the surface of the wafer W from the focal point of the second image sensing mechanism 13 can be detected automatically.

As shown in FIG. 5A, the reflected light from the surface passes through an objective lens 100 and relay lens 200, and is split into two beams with a pupil splitting prism 300, to form two images on a CCD 400. When the surface of an object O and the focal point of

the objective lens 100 coincide (in-focus state), two
light quantity distributions 501 separate from each
other by a predetermined distance (e.g., distance
between barycenters, distance between peaks) are formed
in a photosensor 500. The relationship between the
surface of the object O and the CCD is conjugate with
that between the objective lenses 100 and 200. As
shown in FIG. 5B, if the surface of the object O is
shifted forward from the focal point of the objective
lens 100 by a distance δ, the images obtained by pupil
splitting of the pupil splitting prism 300 form behind
the CCD 400. In comparison to the case of FIG. 5A, the
distance between the two light quantity distributions
obtained by the photosensor 500 decreases. This
smaller distance (defocus amount) ΔL satisfies $\Delta L = 2\delta \tan\theta$, as shown in FIG. 5C. Conversely, when the
surface of the object O is shifted backward from the
focal point of the objective lens 100 by the distance
δ, although not shown, the images obtained by pupil
splitting of the pupil splitting prism 300 form in
front of the CCD 400. Consequently, the distance
between the two light quantity distributions in the
photosensor 500 increases. This larger defocus amount
ΔL satisfies $\Delta L = -\delta \tan\theta$, although not shown.
Therefore, whether the surface of the wafer W is at the
focal point of the objective lens 100, is shifted
forward from it, or is shifted backward from it can be

detected from the distance between the pair of light

quantity distributions, together with the defocus

amount. In addition, the defocus amount from the focal

point of the object O can be automatically calculated

on the basis of the characteristics of the optical

components of the focal point detection unit and the

distance between the light quantity distributions after

pupil splitting.

In this embodiment, the reflected lights of light

(131F' in FIG. 4) irradiating the two portions outside

the electrode pad P on the wafer W pass through the

apertures 161A of the second visual field limiting

member 161, are split into two beams with the pupil

splitting mirror 163, and reach the photosensor 166.

Consequently, two pairs of light quantity distributions

① - ④ are formed on the photosensor 166, as shown in

FIG. 6. Alternatively, the light quantity

distributions can be a pair of light quantity

distributions. The photosensor 166 photoelectrically

converts the detected signals. The photoelectrically

converted signals are input to an arithmetic operator

168 through an A/D converter 167. The arithmetic

operator 168 calculates the distances between the two

pairs of light quantity distributions (e.g., distances

between barycenters, distances between peaks) shown in

FIG. 5 on the basis of the input signals. The average

value of the two pairs of light quantity distributions

is obtained on the basis of the arithmetic values. The defocus amount between the surface of the electrode pad P and the focal position of the second image sensing mechanism 13 is obtained on the basis of this average

5 value. The defocus amount is output to the control unit 14. The control unit 14 drives a driving unit 17 on the basis of the arithmetic values from the arithmetic operator 168. The driving unit 17 moves the main chuck 11 by an amount corresponding to the defocus

10 amount. As a result, the surface of the electrode pad P is leveled at the focal point of the second image sensing mechanism 13. The surface height of the electrode pad P at this time can be stored in the storage of the control unit 14. After that, the second

15 image sensing mechanism 13 image-processes the detected signals of the CCD 139. Thus, a sensed image can be displayed on the screen of the display unit 9 (FIG. 1). With this series of operations, the surface height of the electrode pad P on the main chuck 11 is

20 automatically detected and stored. After that, with the probe being in contact with the electrode pad P, the electrical characteristics of the chips formed on the wafer W are measured.

A probing method according to this embodiment will

25 be described with reference to FIGS. 7 and 8.

The main chuck 11 is driven by the driving unit 17 under the control of the control unit 14. When the

first image sensing mechanism 12 senses predetermined four probes 8A (FIG. 1), the X, Y, and Z positions of the respective probes are detected (step S1). The first image sensing mechanism (lower camera) 12 and second image sensing mechanism (upper camera) 13 are aligned (step S2). The height of the surface of the main chuck 11 or of a load sensor (load cell) 7H provided to the main chuck 11 is detected by the auto focus scheme using pupil splitting described above (step S3). The main chuck 11 moves upward, and the distal ends of the probes come into contact with the load cell (step S4). By step S4, the amount by which the main chuck 11 should move upward during test is detected. The wafer W is placed (loaded) on the main chuck 11 (step S5). The upper and lower cameras 12 and 13 are aligned again (step S6).

After that, the alignment mechanism 7 (FIG. 1) aligns the probes and the wafer W (step S7). The heights of the surfaces of the plurality of chips formed on the wafer W are mapped in the memory (step S8). The main chuck 11 is moved upward, so the probes are brought into electrical contact with the electrode pads of the chips formed on the wafer W (step S9). In this state, the electrical characteristics of the respective chips on the wafer W are sequentially measured.

In step S8, mapping of the surface heights of the

electrodes of the plurality of chips formed on the wafer W can be performed for all or some of the chips by utilizing the auto focus scheme employing pupil splitting described above. This mapping can be performed with the procedure shown in FIG. 8. The above steps S1 to S8 can be performed by appropriately changing their order.

In FIG. 8, a chip number i in the register of the control unit 14 is set to 0 (step S11). The main chuck 11 is moved so that the initial chip is positioned immediately under the objective lens 132 (step S12). A number j of an electrode pad P in the register of the control unit 14 is set to 1 (step S13). When a predetermined electrode pad P is moved to immediately below the objective lens 132, the electrode pad P (J) is positioned within the visual field of the second image sensing mechanism 13, as shown in FIG. 4 (step S14). The surface height of the electrode pad P (J) is obtained by using the focal point detection unit 16 having pupil splitting (step S15).

Detection of the surface height by pupil splitting in step S15 can be performed with the following procedure. Observation light is irradiated by the light source 131A of the second image sensing mechanism 13. The irradiation light is focused by the condenser lens 131B, passes through the first and second apertures 131E and 131F of the second visual field

limiting member 131C, then through the relay lens 131D, turns its optical path by the first half mirror 133, passes through the objective lens 132, and irradiates the wafer W. The irradiated region corresponds to the electrode pad P of the chip formed on the wafer W, as shown in FIG. 3, because it is limited by the first and second apertures 131E and 131F. The reflected light of this irradiation passes through the objective lens 132, half mirror 133, and relay lens 134, and turns its optical path through the half mirror 135. The reflected lights corresponding to the second apertures 131F are blocked by the first visual field limiting member 136. As a result, only the reflected light corresponding to the first aperture 131E passes through the relay lenses 137 and 138 and is detected by the CCD 139. At this stage, the surface of the electrode pad P does not always coincide with the focal point of the second image sensing mechanism 13.

Part of the light reflected by the wafer W is transmitted through the half mirror 135 and becomes incident on the focal point detection unit 16. This incident light is limited by the second visual field limiting member 161, and only beams that have been transmitted through the two apertures 161A are split into two beams with the pupil splitting mirror 163. The two split light beams pass through the relay lenses 164 and 165 and are detected by the photosensor 166.

The photosensor 166 detects the two pairs of light
quantity distributions 501 (see FIGS. 5 and 6)
corresponding to the two apertures 161A. At this
stage, when the surface of the electrode pad P of the
5   wafer W is behind the focal point of the second image
sensing mechanism 13, the distance between the light
quantity distributions of each pair is larger than that
when the electrode pad P is at the in-focus position.
The photosensor 166 photoelectrically converts the
10   received light, and outputs the converted signal to the
arithmetic operator 168 through the A/D converter 167.
The   operator 168 calculates the average
value of the distances A and B (see FIG. 6) between the
two pairs of light quantity distributions on the basis
15   of this signal. The defocus amount of the surface of
the electrode pad P is obtained on the basis of this
average value. The arithmetic operator 168 outputs the
arithmetic operation result to the control unit 14.
The control unit 14 drives the driving unit 17 such
20   that the main chuck 11 is moved, the defocus amount is
corrected, and the surface of the electrode pad P is
leveled at the focal point of the second image sensing
mechanism 13. As a result, auto focus of the electrode
pad P is ended, and the Z position of the main chuck 11
25   (i.e., the surface height of the electrode pad P) is
detected. In this manner, the focal point detection
unit 16 can obtain both the defocus direction and

defocus amount concerning the surface height of the electrode pad P simultaneously. To focus the wafer W, conventionally, the main chuck 11 is excessively moved vertically. In this embodiment, the main chuck 11 can be auto-focused with the surface of the main chuck 11 by one upward operation of the electrode pad P, and a time required for focusing can be shortened.

When the focal point detection unit 16 ends auto focus for the electrode pad P in the above manner, the value of the register j is incremented (step S16). Whether the number of electrode pads P that are auto-focused reaches a predetermined number (e.g., 4) is checked (step S17). If the auto-focused number is less than the predetermined number, steps S14, S15, and S16 are performed again. In step S17, if the auto-focused number reaches the predetermined number, the surface heights of the predetermined number of electrode pads P are stored in the storage (step S18). The value of the register i is incremented (step S19). Whether the surface heights of the electrode pads P of all the chips N are detected is checked (step S20). If any chip remains undetected, the operation of steps S12 to step S18 is repeated. When the surface heights of all chips are mapped, the mapping operation of the wafer W is ended. The above steps S11 to S20 can be performed by appropriately changing their order.

As has been described above, according to this

embodiment, in probe test of the wafer W, auto focus by means of pupil splitting is utilized to detect the surface heights of the plurality of chips formed on the wafer W. As a result, the surface heights of the

5   electrode pad P are detected by only moving the main chuck 11 downward or upward by an amount corresponding to the defocus amount. Thus, the auto focus time is remarkably shortened when compared to the prior art, and the test throughput is increased.

10   Since the surface heights of all the chips formed on the wafer W are detected, the main chuck 11 can be operated on the basis of the steps of each chip, and a stable needle pressure can be obtained for each chip, so that a highly reliable test can be performed.

15   In the above embodiment, the surface heights are detected for all the chips on the wafer W. Alternatively, the surface heights of a predetermined number of chips may be detected where necessary. The test target object is not limited to a wafer.

20   The embodiment of the present invention can provide a probing method and prober with which the surface height of the individual electronic circuit device formed on a test target object is detected quickly, so that the throughput is increased and a

25   highly reliable test is performed with a stable needle pressure.

The steps in the probing method of the present

invention can be performed by appropriately changing their order.